120mm LOS/BLOS
(Line Of Sight / Beyond Line Of Sight)

Advanced Technology Demonstrator

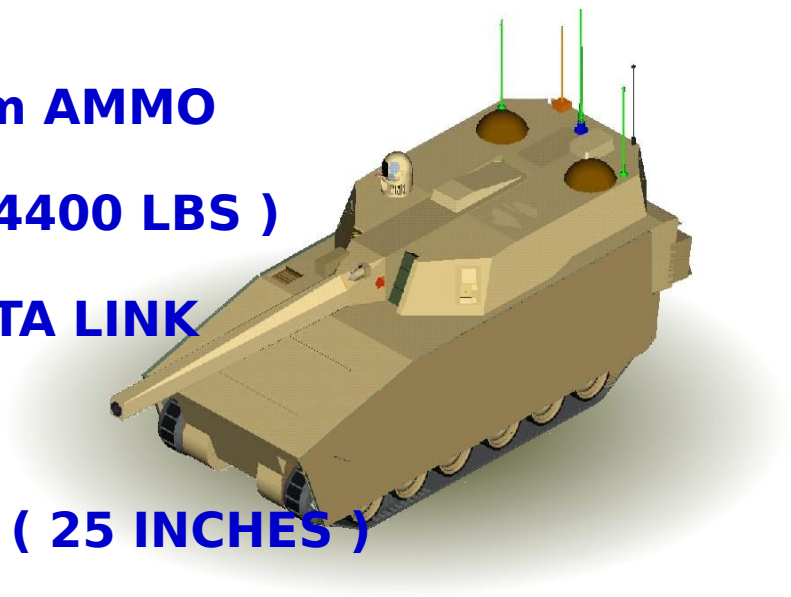
Anthony Cannone
Mechanical Engineer

120mm LOS/BLOS ATD

Gun Assembly IPT

Develop new Light Weight 120mm Gun Assembly for use with the Army's Mounted Combat System (MCS)

- **M829A3 LETHALITY**
- **COMPATIBLE WITH CURRENT 120mm AMMO**
- **WEIGHT NOT TO EXCEED 1995 kg (4400 LBS)**
- **COMPATIBLE WITH AMMUNTION DATA LINK**
- **ELECTRICAL BREECH ACTUATION**
- **MAXIMUM RECOIL STROKE: 559mm (25 INCHES) ***
- **MAXIMUM TRUNNION FORCE: 378,097 n @ 23,575 n-sec * (85,000 lb @ 5300 lb-sec)**

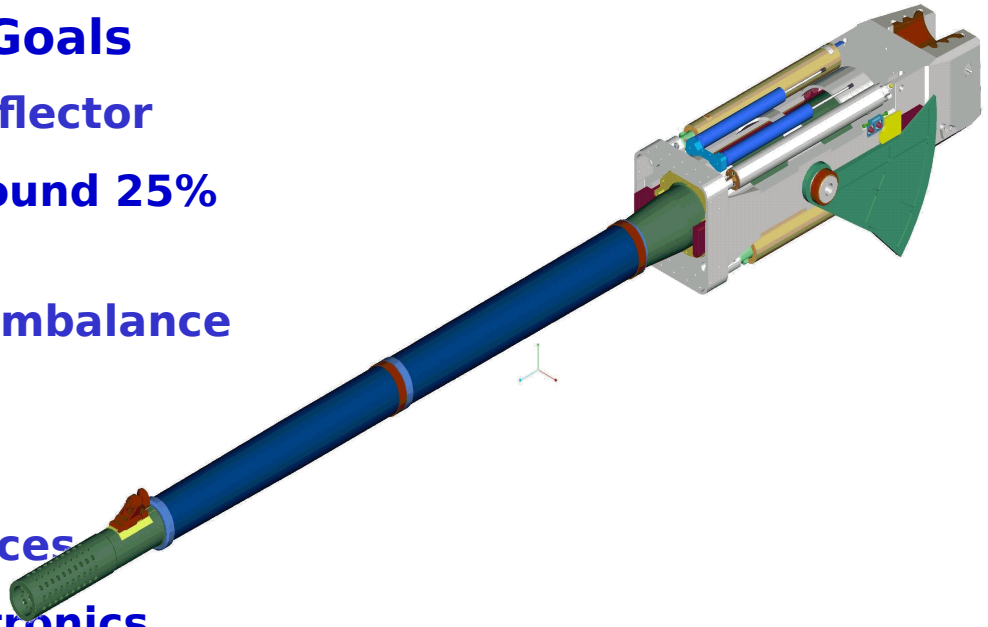


120mm LOS/BLOS ATD

Gun Assembly IPT

Overall Goals

- Develop Muzzle Brake & Blast Deflector
  - Reduce Impulse of M829A3 round 25%
  - Mitigate Muzzle blast
- Reduce Gun Assembly Weight & Imbalance
  - Replace Steel with Titanium
  - Use Composite Materials
- Establish Ammo Data-Link Interfaces
  - Integrate Hardware and Electronics
- Fabricate & Test Breech Mechanism Assembly
  - Develop Control Software and Electronics
- Fabricate & Test Gun Tube Shrouds
  - Establish Gun interfaces
  - Verify thermal shroud performance

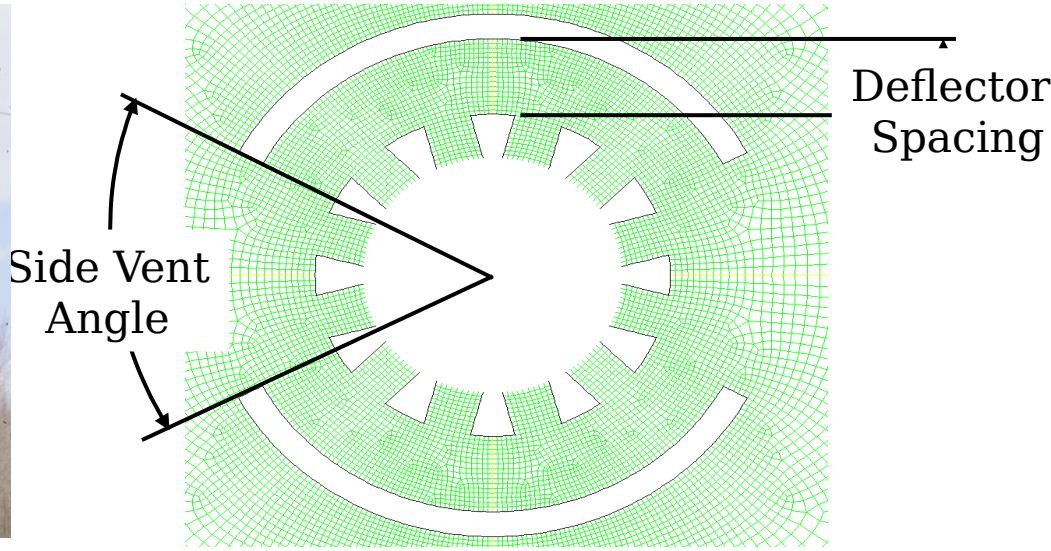


120mm LOS/BLOS ATD

Gun Assembly IPT

Muzzle Brake & Blast Deflector

- **Optimize Design of muzzle brake & blast deflector to achieve:**
  - **25% recoil impulse reduction**
  - **Mitigate blast seen by vehicle.**
- **3 to 6 brake / deflector designs will be test fired.**
  - **Design Parameter variations: Side vent angle & Tube-Deflector Spacing**

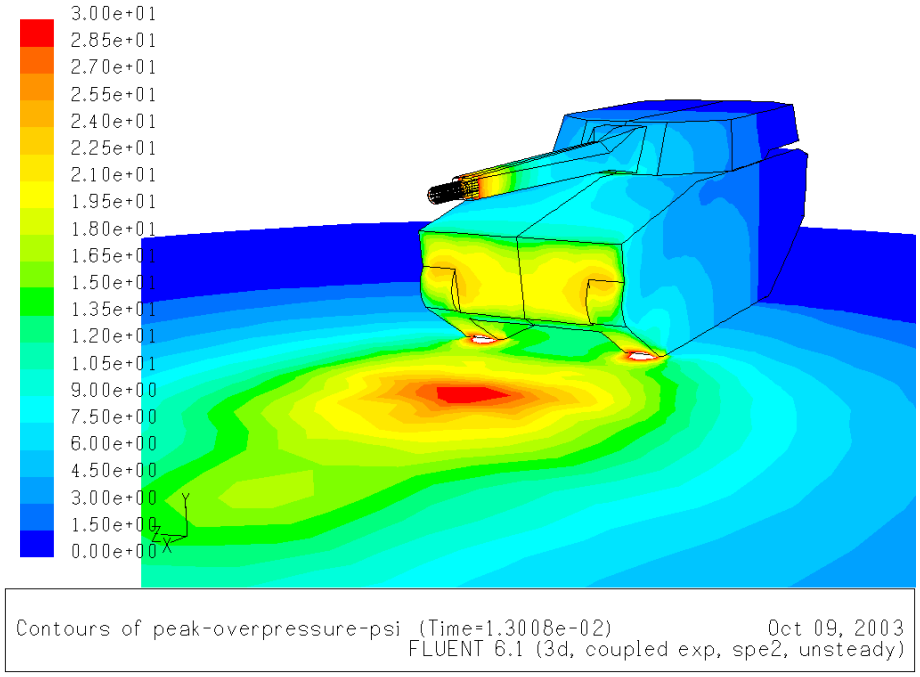


120mm LOS/BLOS ATD

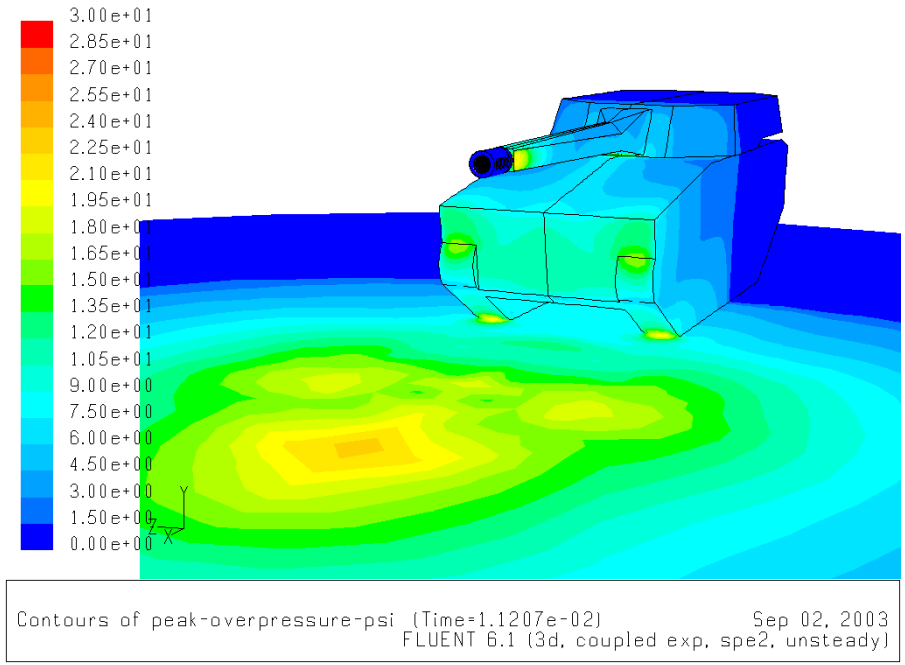
Gun Assembly IPT

Computational Fluids Dynamics Modeling

LW-120 Blast Deflector Comparison – 50% Reduction in BOP



Muzzle Brake With Out Deflector



Muzzle Brake With Blast Deflector #1

120mm LOS/BLOS ATD

Gun Assembly IPT

Composite Wrapped Gun Tube

- Fabricate & Test Fire Two (2) Full size Gun Tubes
  - Tube No. 1 - May 04
  - Tube No. 2 - Sept 04
- Determine design criteria to mitigate Dynamic Strains/Resonance conditions
- Improve Composite Jacket Design
- Develop Fabrication Methodology
  - Develop/Optimize “wind in tension” process
  - Material characterization / optimization
  - Characterize Residual stresses developed
  - Address Fatigue / Fracture concerns

120mm LOS/BLOS ATD

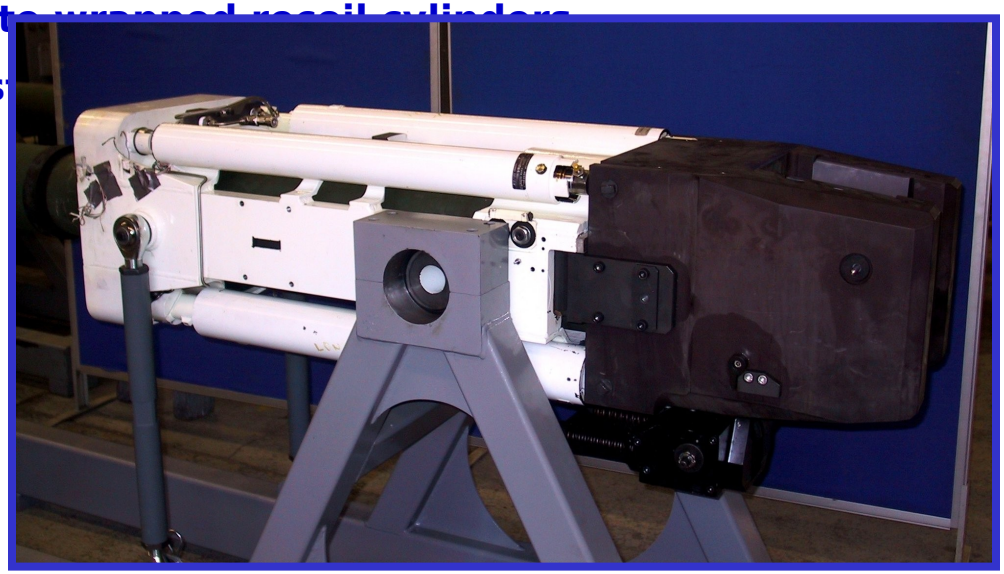
Gun Assembly IPT

Gun Mount Assembly

- Fabricate Cradle with MCS Turret & Ammo Handling System Interfaces.
- Reduce weight of Recoil system using Titanium & Composites.
  - Review Current Design & Replace Steel parts with Titanium.
  - Design & Fabricate composite wrapped recoil cylinders
  - Conduct Gymnastication Test
  - Weight Goals:

    Current: 949lbs

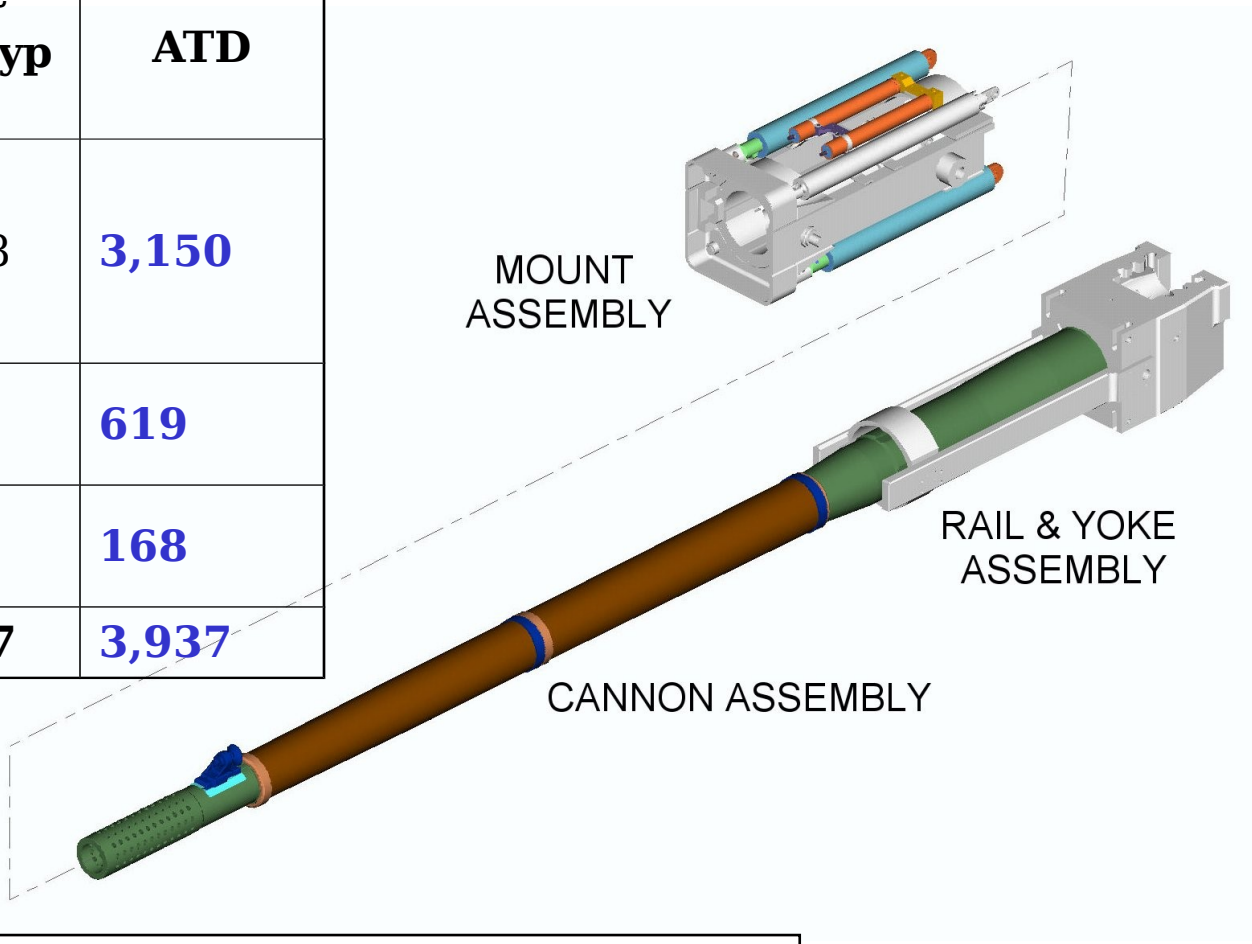
    ATD Weight: 787 lbs.



120mm LOS/BLOS ATD

Gun Assembly IPT

COMPONENT WEIGHT (lb)		
	First Prototype	**ATD**
Cannon Assembly (Breech & Tube Assemblies)	3,268	**3,150**
Gun Mount Assembly	675	**619**
Rails & Yoke Assembly	274	**168**
Total	**4,217**	**3,937**



120mm LOS/BLOS ATD
Gun Assembly IPT

AMMUNITION DATA LINK

DEVELOPMENT ACTIVITIES

Munition

- Refine D/L for 120mm Config.
- Refine D/L Protocol
- Conduct Static FEA on Stub Case
- Fabricate Hardware
- Validate FEA
- Develop D/L Emulator
- Support LOS/BLOS ATD D/L Demo
- Design Modifications

Armament

- Refine Breech Block Design
- Refine D/L Protocol
- Conduct Static FEA Breech Block
- Fabricate & Integrate Signal Hardware
- "Signal Transfer" Check-out
  - Prior to APG Ship
- LOS/BLOS Design Demo Support
- Design Modifications

120mm LOS/BLOS ATD

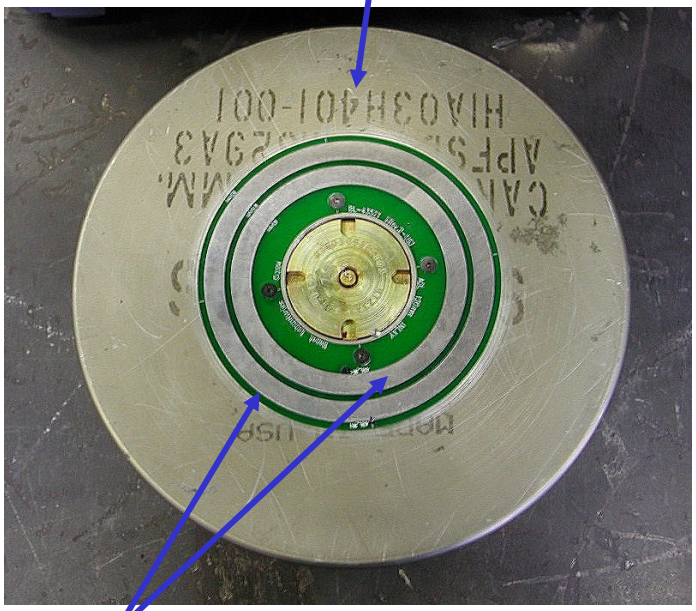
Gun Assembly IPT

AMMUNITION DATA LINK

DESIGN FEATURES

- Bi-Directional, Two Wire Interface with Concentric Rings
- Transmit Data and Power Independently
- Manchester Encoded Data
- Baud Rate > 200 KHz
- Message Format to be Command/ Response System
- Transmission Time < 0.3 Seconds
- Compatible With German Single Pin
- Investigating Actuated Data Pins for Compatibility

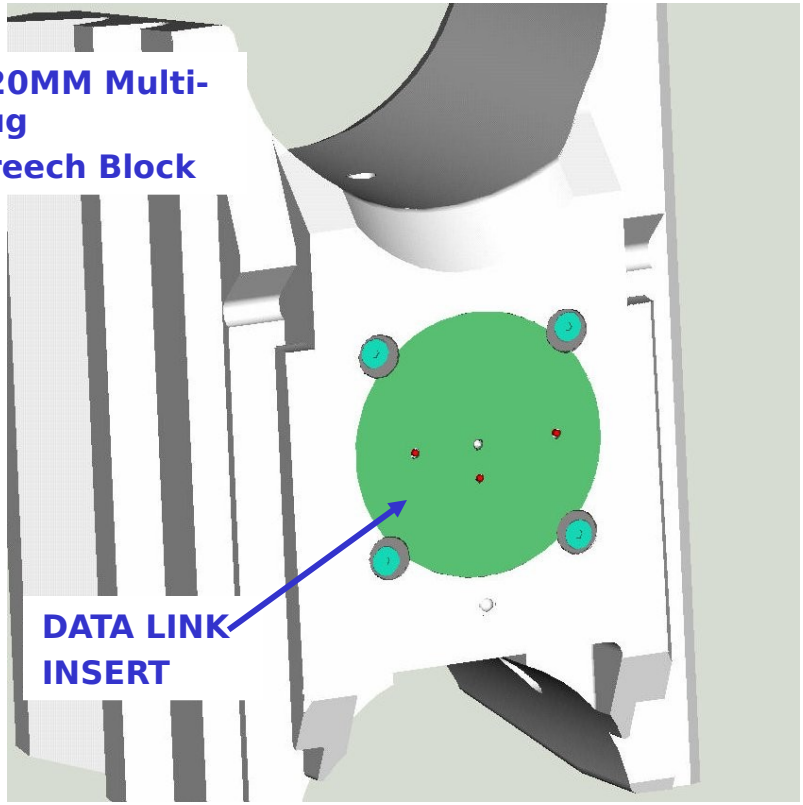
With Precision Ignition

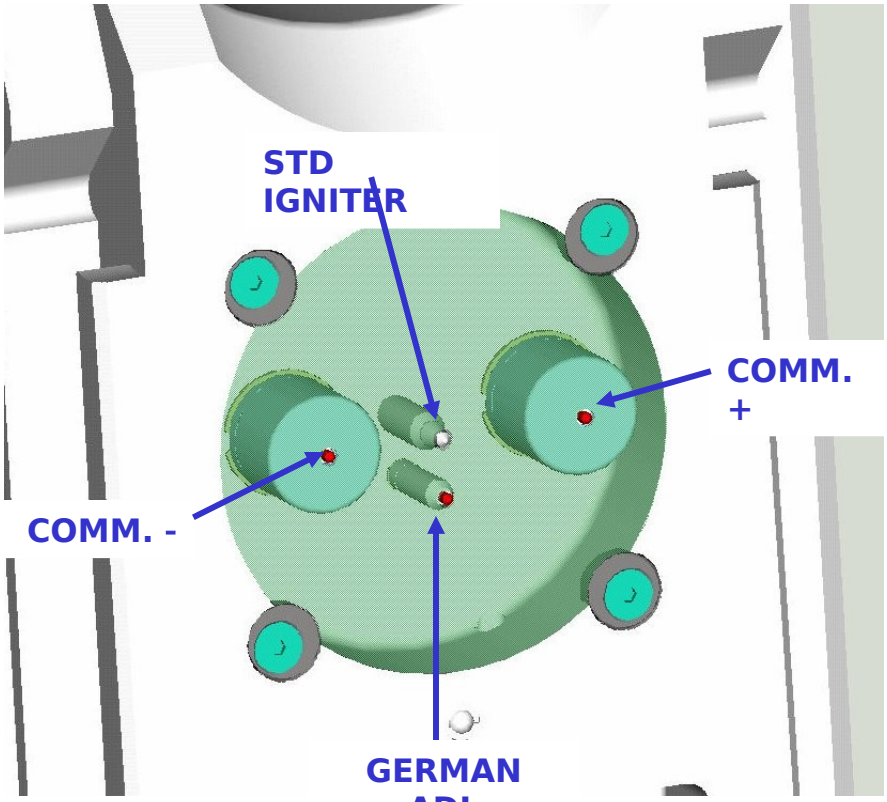


120mm LOS/BLOS ATD

Gun Assembly IPT

AMMUNITION DATA LINK
ARMAMENT DESIGN FEATURES





120mm LOS/BLOS ATD

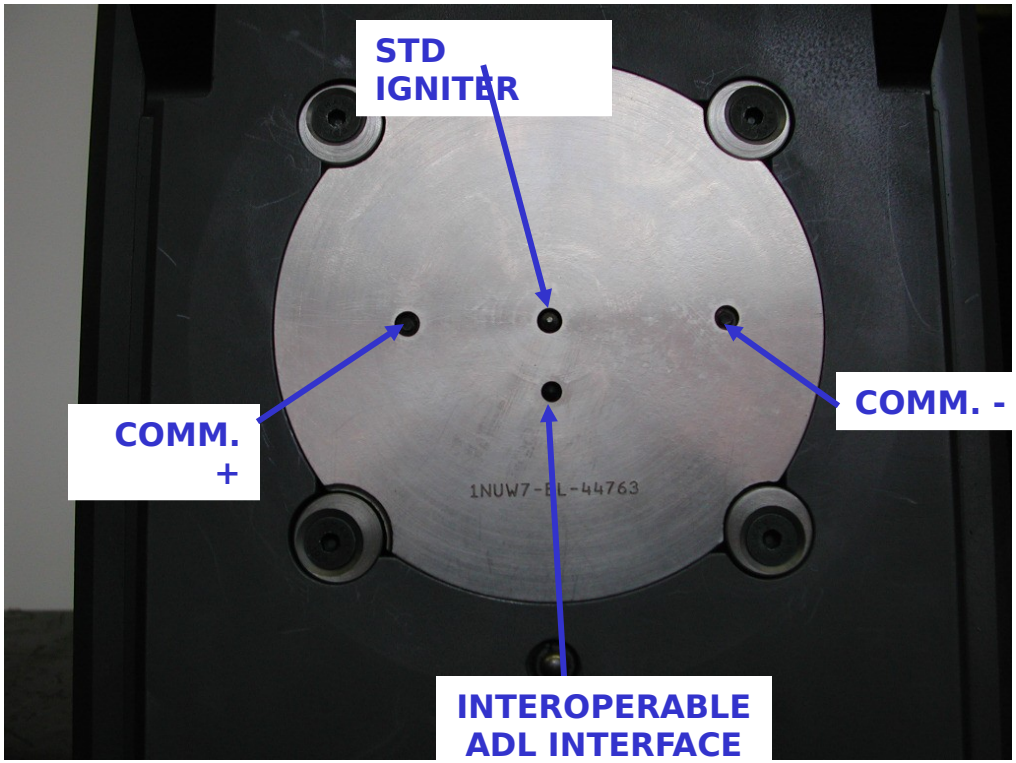
Gun Assembly IPT

AMMUNITION DATA LINK

120MM Multi-Lug Breech Block

DATA LINK INSERT

INSTRUMENTED CASE BASE



Breech Actuation System

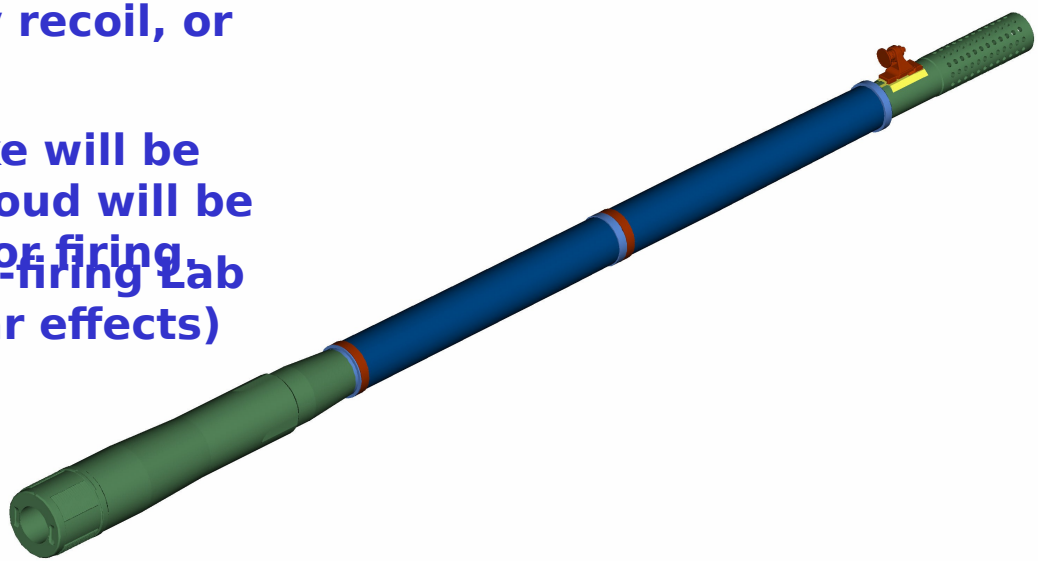
- **Electric Breech Actuation Mechanism**
  - Slide Block – Downward Opening
  - Block Travel: approximately 200mm
  - Maximum Breech Closing Time: 0.4 sec
  - Maximum Breech Opening Time: 0.4 sec
  - Gas Spring Equilibrator To Balance Block Weight
  - Motor Type: 600 Volt brush-less DC servomotor
  - Block Position Sensors for Open / Close
  - Electrical Make-Break Connector for Position Sensors
  - Non-Recoiling Motor & Gearbox utilizes Mechanical Make-Break

120mm LOS/BLOS ATD

Gun Assembly IPT

Tube Assembly

- **Design & Fabricate Gun Tube Shrouds, Thermal & Survivability**
  - **Establish interfaces required to gun tube, cradle & Gun Shield.**
  - **Determine whether survivability shroud will recoil, partially recoil, or not recoil at all.**
  - **Determine if Muzzle brake will be covered, and if so how shroud will be actuated off of the brake for firing.**
  - **Shrouds will undergo non-firing Lab Tests (shrouding from Solar effects) & Firing Tests.**



120mm LOS/BLOS ATD
Gun Assembly IPT

KEY MILESTONES

- **Firing Test No. 1 – Scheduled May 2004.**
  - Muzzle Brake / Blast Deflector.
  - Composite jacketed gun tube
  - Breech block with data-link.
- **Firing Test No. 2 – Scheduled July 2004.**
  - Light Weight Muzzle Brake / Blast Deflector.
  - High strength steel gun tube.
- **Firing Test No. 3 – Scheduled Sept. 2004.**
  - Optimized Muzzle Brake / Blast Deflector.
  - Optimized Composite jacketed / high strength steel gun tube.
  - Light weight Recoil Assembly.
  - Gun Tube Shrouds Demonstrated.
  - Ammo Data Link / Precision Ignition Demonstrated.